Unit 4

Measuring Equipment

Measurement is assigning a value to length, mass and time. Whether building a motor or setting up a suspension, a mechanic heads to take accurate measurements to be able to make accurate adjustments, this unit will teach you about using measuring tools and making accurate measurements.

Instruments used for measuring basic units, such as mass, length and time or derived units, such as speed, acceleration, pressure, etc., are called measuring instruments or equipment.

It is important for an automotive technician to know which tool is the right one for the automotive part to be measured. This unit will cover the use of precision measuring equipment like gauges, etc., which are required for repair and maintenance of automobiles.

SESSION 1: HANDLING AND USAGE OF DIRECT AND INDIRECT MEASURING INSTRUMENTS

We all use some kind of measurement tools in our daily life. Similarly, the automotive industry also uses measurement equipment, which are important for determining the dimensions of any given object. Some examples of these tools are dial gauge, bore gauge, vernier caliper, depth gauge, micrometer, hydrometer and multi meter, etc. We will now try to understand the handling and usage of these measuring equipment.

Measuring Instruments

Measuring instruments used in the automotive industry can be classified as follows:

1. Linear measurement
    - Direct measuring instruments
    - Indirect instruments for transferring measurements
2. Angular measurement
3. Plane surface measurement

Direct Measuring Instruments

The instruments, which do not require the help of other instruments for measuring are called direct measuring instruments. Usually, these instruments have a line, which is divided in equal parts, called graduated scale. Some commonly used direct measuring instruments are:

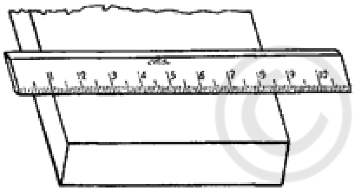


Fig. 4.1: Scale

Steel scale or rule

It is one of the simplest and most commonly used measuring device. A scale is made of a strip of hardened steel having line graduations marked at regular intervals. The length of a scale can be variable, it may be of either 150 mm long or 300 mm or 600 mm or 1000 mm long. Fig.4.1 shows a scale.

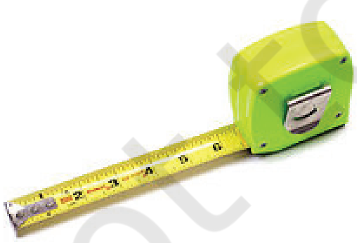


Fig. 4.2: Steel tape

Steel tape

A steel tape is made of steel or stainless steel. It is a flexible ruler to measure round curves or corners. A 2–3m length tape can be used in workshops. Fig.4.2 shows a steel tape.

Vernier caliper

It is an instrument used to measure internal and external distances precisely. The vernier caliper is generally a manual caliper, used in manufacturing for quality control. Fig.4.3 shows a vernier caliper.

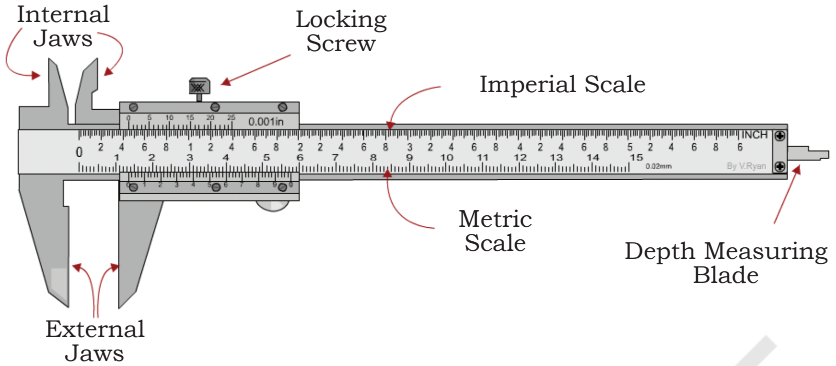


Fig. 4.3: Vernier caliper and its parts

Parts of a vernier caliper

- Outside jaws: used for measuring external length or width of an item.
- Inside jaws: measures the internal diameter of an object.
- Depth probe: computes the depths of an object or a hole.
- Main scale: scale marked in mm, inches and fractions.

A vernier caliper measure measurements upto 0.1 mm or more.

It also gives the result of measurements in fractions of an inch.

In a vernier caliper, the sliding jaw consists of the vernier scale, which moves over the main scale. When the two jaws come in contact, the main scale zero and the zero of the vernier scale must coincide. If both the zeros do not meet, there may be a positive or negative zero error.

The vernier scale has a main scale. On the vernier scale 0.9 cm is divided into ten equal parts. The least count or the smallest reading which we get with the instrument is calculated.

Least count = one main scale (MS) division – one vernier scale (VS) division.

Suppose 10 divisions of vernier scale = 9 division of main scale. Therefore, one division of vernier scale = 9/10 = 0.9 mm of main scale division (one division of main scale = 1 mm). Therefore, the least count will be

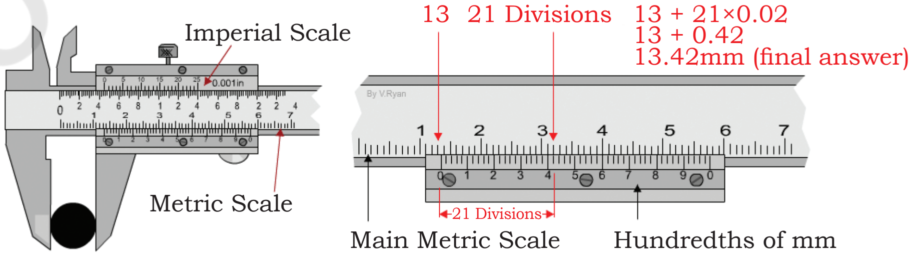
= 1 mm – 0.9 mm
= 0.1 mm
= 0.01 cm

Reading the vernier caliper and measuring the diameter of the cylinder

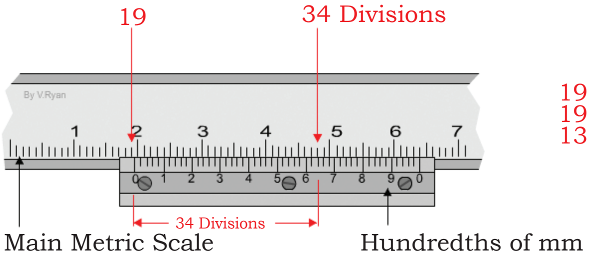
1. The sliding jaw is moved along the beam until it comes in contact with the cylinder kept against the fixed jaw. In this way the cylinder is held between the fixed and sliding jaw.
2. The sliding jaw assembly is clamped to the main beam with the help of a fine adjustment screw.
3. The knife edges of two jaws are now in contact with the cylinder.
4. The main slide assembly is then locked to the beam with the help of a retainer.
5. Remove the cylinder held in the jaws for reading the measurement or read the caliper when the cylinder is held in the jaws.
6. Read the main scale left to the zero of the vernier scale.
7. Read the vernier scale division, which coincides with the main scale division.
8. Multiply the reading of vernier scale with the least count and add it to the main scale reading to arrive at the final reading.

For example, 50 divisions on the vernier scale = 49 division on main scale. The value of one division on main scale is 1mm. Therefore, the least count = 1–49/50 = 0.02 mm

Example 1



Example 2



19 + 34×0.02
19 + 0.64
13.64mm (final answer)

Dial caliper

A dual caliper has a graduated scale and a dual indicator.

It consists of a small precise gear rack drive, which reads the reading.

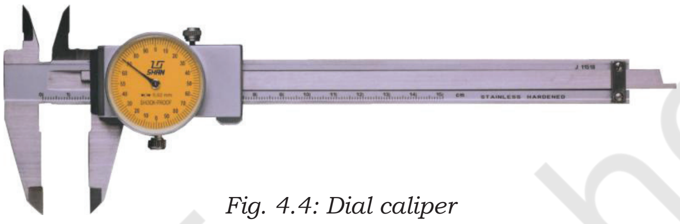


Fig. 4.4: Dial caliper

Digital caliper

It is an electronic digital caliper on which the reading is displayed as a single value. Digital calipers consist of 'reading hold' feature, which allow the reading of dimensions easily in awkward locations also.

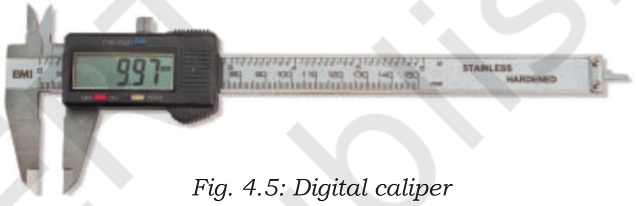


Fig. 4.5: Digital caliper

Digital calipers are made of stainless steel. Digital calipers have an accuracy of 0.02mm and a resolution of 0.01mm.(Fig.4.5).

Vernier depth gauge

It is used for measuring distances from a plane surface to a projection, the depth of holes. In this depth gauge, the graduated scale can slide through the base and the vernier scale remains fixed. The reference surface on which the depth gauge base is rested should be flat and square in shape (Fig.4.6).

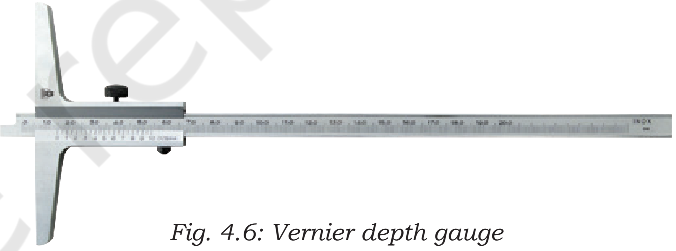


Fig. 4.6: Vernier depth gauge

Micrometer

It is a measuring instrument, used for inspecting and measuring the distance between two faces.

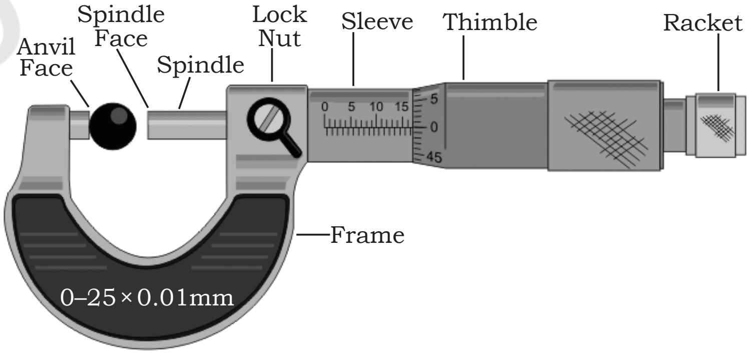


Fig. 4.7: Micrometer and its parts

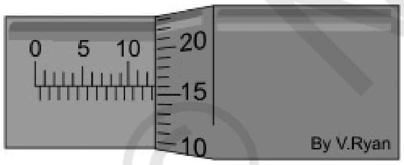
The object to be measured is kept between the spindle face and anvil face. Then the ratchet is rotated clockwise till the object is held between two surfaces and the ratchet makes a special noise. This indicates that the rachet cannot be tightened any further and the measurement should be read (Fig.4.7).

Calculation of least count of a micrometer
Least Count (L. C) = Pitch/No. of divisions on micrometer barrel (thimble) where, Pitch = distance travelled by thimble on a linear scale in one rotation, which is usually 0.5 mm, unless mentioned.

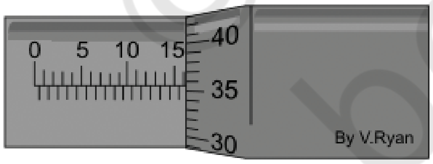
For example, the number of divisions on the barrel are 50. Therefore, the least count of the micrometer will be 0.5/50 = 0.01

1. Read the scale on the sleeve. The example shows 12 mm divisions.
2. Still reading the scale on the sleeve, a further ½ mm (0.5) measurement can be seen on the bottom half of the scale. The measurement now reads 12.5mm.
3. Finally, the thimble scale shows 16 full divisions (16 × 0.01 = 0.16 mm).

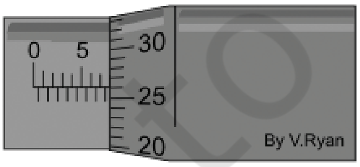
The final measurement is 12.5mm + 0.16mm = 12.66 mm



Sleeve Reads Full mm = 12.00
Sleeve Reads ½ mm = 0.50
Thimble Reads = 0.16
Total Measurement = 12.66 mm



Sleeve Reads Full mm = 16.00
Sleeve Reads ½ mm = 0
Thimble Reads = 0.355
Total Measurement = 16.355 mm



Sleeve Reads Full mm = 7.00
Sleeve Reads ½ mm = 0.50
Thimble Reads = 0.26
Total Measurement = 7.76 mm

Digital micrometer

The digital micrometer is shown is the figure and display the final reading. Micrometers are classified as per the type of anvil and spindle faces such as gear tooth micrometer, sheet metal micrometer, etc.

Micrometer head is part of any measuring instrument which makes the instrument known with prefix as micrometer, such as micrometer depth gauge, micrometer bore gauge, etc. A digital micrometer is shown in Fig.4.8.

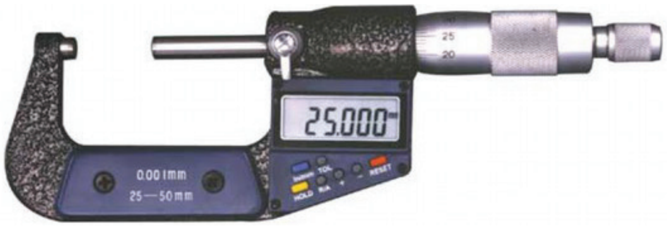


Fig. 4.8: Digital micrometer

Indirect Measuring Instruments

The simple calipers can be used in these situations. For measuring, the object is held between the ends, object removed and the ends are placed on steel scale to determine the distance. These calipers can be used to calculate the length, outside and inside diameters. Some of the calipers are as given below:

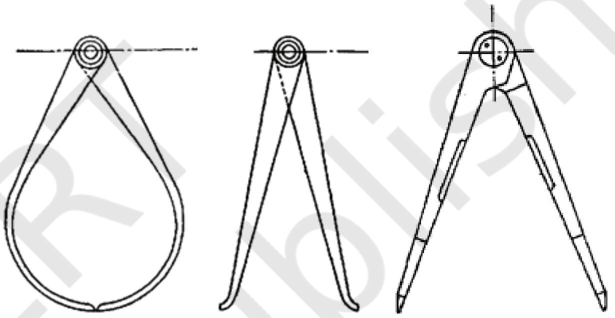


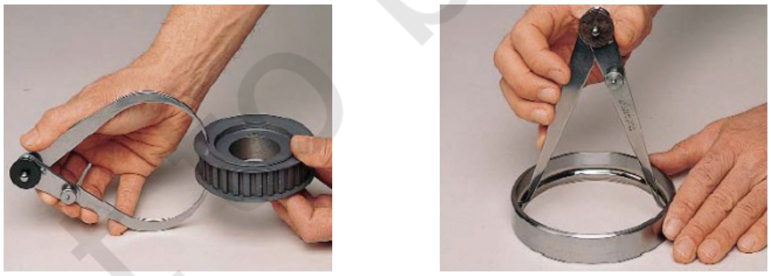
Fig. 4.9: Firm joint calipers: outside, inside and divider

Firm Joint Calipers

This device is used to compare measurements against known dimensions. It has two legs which are joined together by a rivet. The legs are set properly so that the working ends meet evenly and closely. The nominal sizes of joint caliper are 100 mm, 150 mm, 200 mm and 300 mm. Figure 4.9 shows different type of calipers.

Spring Joint Calipers

The functions of these calipers are similar to firm joint calipers. The legs of this caliper can be opened and closed by screwing the nut in and out of the bolt (Fig.4.10).



Measuring outside dimension

Checking inside groove

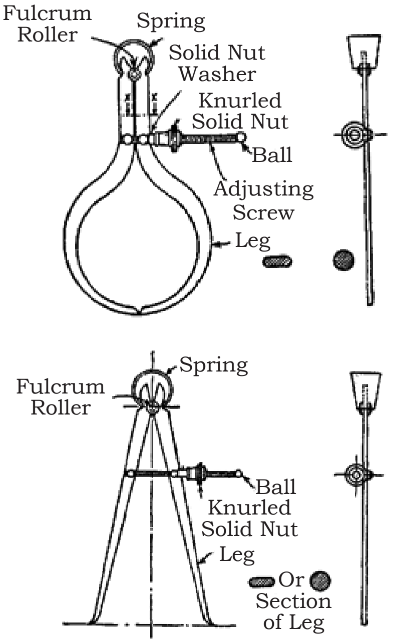


Fig. 4.10: Spring joint calipers: Outside and Inside

Practical Exercise

1. Make a list of direct and indirect measuring instruments.

S.No.	Name of instrument

2. Draw the line diagram of vernier caliper and micrometer, and label the parts.

Check Your Progress

A. Fill in the blanks

1. A ____________ is assigning a value to length, mass and time.
2. The measuring instruments, which do not require the help of other __________ for measuring are called ______________ measuring instruments.
3. Steel scale or rule is the __________ measuring tool.
4. The vernier caliper is a __________ tool used to measure __________ and external distances accurately.
5. In the vernier calliper the sliding jaw containing the ___________ scale, moves over the main scale.
6. For measuring the depth of __________, recesses and __________ from a plane surface to a projection, the vernier depth gauge is employed.
7. The micrometer is a precision measuring instrument, used by engineers and technicians for __________ and measuring the distance between two __________.
8. The digital micrometer the ____________ reading.

B. Multiple choice questions

1. Direct measuring instruments have a line, which is divided in equal parts, called ________________.
   (a) graduated scale
   (b) firm joint calipers
   (c) spring joint meter
   (d) All of the above
2. Which measuring instrument is used to measure internal and external distances precisely?
   (a) Vernier caliper
   (b) Spring joint meter
   (c) Micrometer
   (d) None of the above
3. The least count or the smallest reading which we get with the vernier caliper is calculated as ____________.
   (a) 0.01 cm
   (b) 0.001 m
   (c) 0.0001 cm
   (d) None of the above
4. Digital calipers are made of _____________.
   (a) stainless steel
   (b) iron
   (c) copper
   (d) aluminium
5. Which devices are used for comparing measurements against known dimensions?
   (a) Firm joint calipers
   (b) Spring joint callipers
   (c) Micrometer
   (d) None of the above

C. Answer the following questions

1. Give the importance of measuring instruments.
2. What is the difference between direct and indirect measuring instruments?
3. Explain the procedure for determining the least count of vernier caliper.
4. How do you determine the least count of micrometer?
5. How do we measure using indirect measuring instruments?
6. Differentiate between vernier and digital caliper.
7. Which parameters can be measured with vernier depth gauge?

NOTES

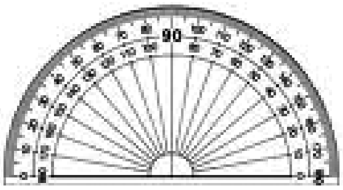


Fig. 4.11: Protractor

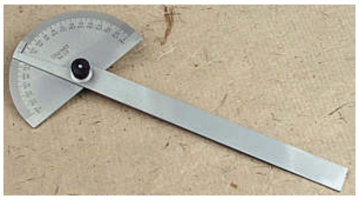


Fig. 4.12: Blade protractor

8. What are the various alert signs found in a dashboard of a vehicle?
9. Take any object round or square. Measure and write the reading with the help of vernier caliper in the table given below.

S. No	Main Scale Reading(A)	Vernier Scale Reading(B)	Least Count (C)	Least Count x Vernier Scale (BxC=D)	Actual Reading (A+D)

Session 2: Angular Measuring Instruments

Instruments used for measuring angles are called angular measuring instruments. Angular measuring instruments include the following:

Protractor

It is a device used for measuring the angle between two intersecting lines (Fig.4.11). The angle is measured in degrees.

Blade Protractor

It is a tool used for setting bevels, transferring angles, small squaring tasks, and many other applications (Fig.4.12).

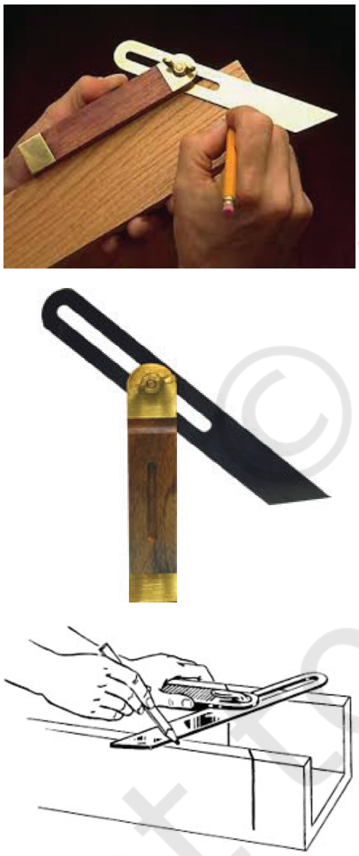
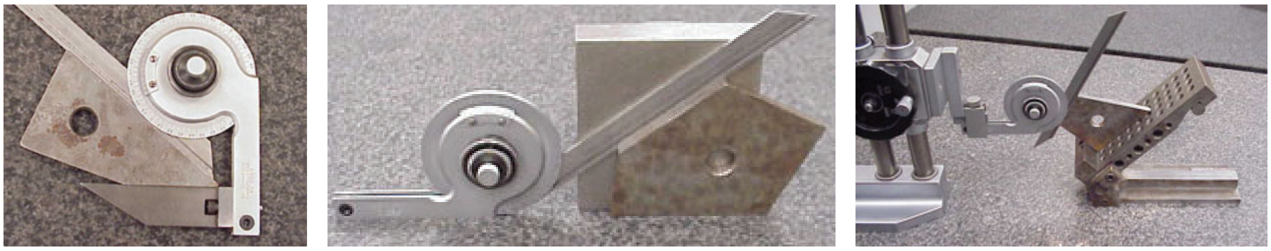


Fig. 4.13: Bevel gauge and its use

Bevel or Combination Gauge

A bevel gauge is also called an adjustable gauge. It is used for setting and transferring angles. The handle is made of wood or plastic or steel and is attached to a metal blade with a thumb screw or wing nut. The blade pivots can be locked at any angle by loosening or tightening the thumb screw. The bevel gauge and its applications are shown in Fig.4.13.

A gauge is used for measuring the angle of valve face and valve seat. The straight edge is used to check the distortion of plain surfaces like the cylinder head and cylinder block.



Measuring acute angles

Measuring obtuse angles

Protractor with a vernier height gauge

Fig. 4.14 (a)

Universal Protractor

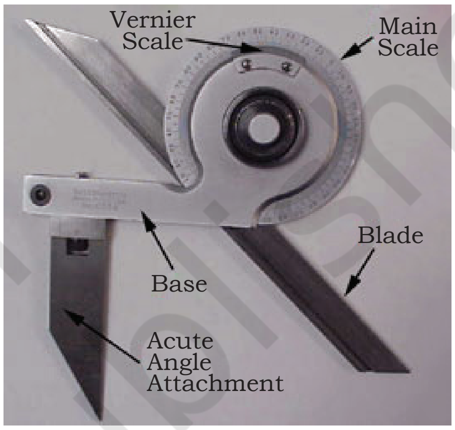


Fig. 4.14 (b): The universal bevel protractor is capable of measuring 1/12 of a degree.

The universal bevel protractor (Fig. 4.14 [a & b]) is used for precision measuring and layout of obtuse angles as well as acute angles. It consists of a main scale and vernier scale.

The main scale is an important component of the bevel protractor and consists of number from 0 to 90 degrees and then back from 90 degrees to 0 (Fig.4.15). Four 90-degree components are graduated in the main scale.

Similarly, with vernier measuring devices, the vernier scale is divided into 24 spaces, 12 spaces on either side of the zero. Each space on the vernier scale is, therefore, one-twelfth of a degree. And one-twelfth of a degree is equal to 5 minutes.

For reading the protractor, the zero on the vernier scale lines up with the degrees on the dial (Fig.4.15). The degrees are read directly from the main scale. The zero on the vernier scale is just after the 85 degree mark. Now, read in the same direction (counter-clockwise), count, by five, from zero on the vernier scale to the lines that match up on the dial (Fig.4.16).

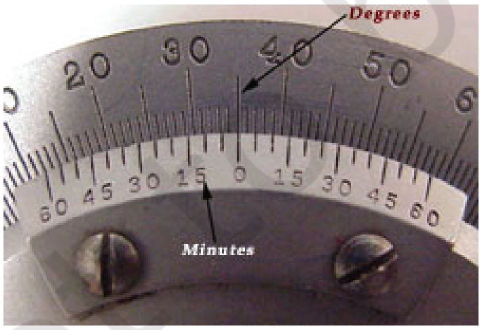


Fig. 4.15: Degrees can be read directly off the main scale, while the minutes are read on the vernier scale.

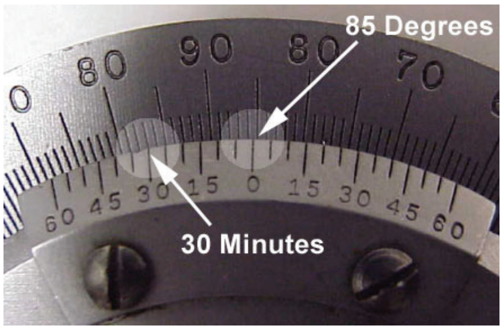


Fig. 4.16: Always read the vernier in the same direction that you read the dial

Add this number of minutes to the number of whole degrees. The total number of degrees and minutes in Fig.4.16 would equal 85 degrees and 30 minutes. See the measurements in the figure to get the correct vernier bevel protractor reading.

Practical Exercise

1. Make a list of angular measuring instruments.

S.No.	Name of instrument

2. Draw the line diagrams of angular measuring instruments and label the parts.

Check your Progress

A. Fill in the blanks

1. Instruments used for measuring the angle are called ___________ measuring instruments.
2. A protractor is a device for measuring the angle between two ___________ lines.
3. The blade protractor has double graduations from 0–180° in ___________ directions permitting the direct reading of angles.
4. A bevel gauge is a (an) ___________ gauge for setting and ___________ angles.
5. The universal bevel protractor is designed for _________ measuring and __________ of angles.

B. Multiple choice questions

1. Instruments used for measuring angles are called ________________________.
   (a) angular measuring instruments
   (b) gauge
   (c) micrometer
   (d) None of the above
2. Which device is used for measuring the angle between two intersecting lines?
   (a) Protractor
   (b) Scale
   (c) Caliper
   (d) Screw-gauge
3. Bevel or combination gauge is used to measure ________________________.
   (a) setting and transferring angles
   (b) depth
   (c) length
   (d) accurate angle
4. Which device is used for precision measuring and layout of angles?
   (a) Universal Protractor
   (b) Combination gauge
   (c) Caliper
   (d) None of the above

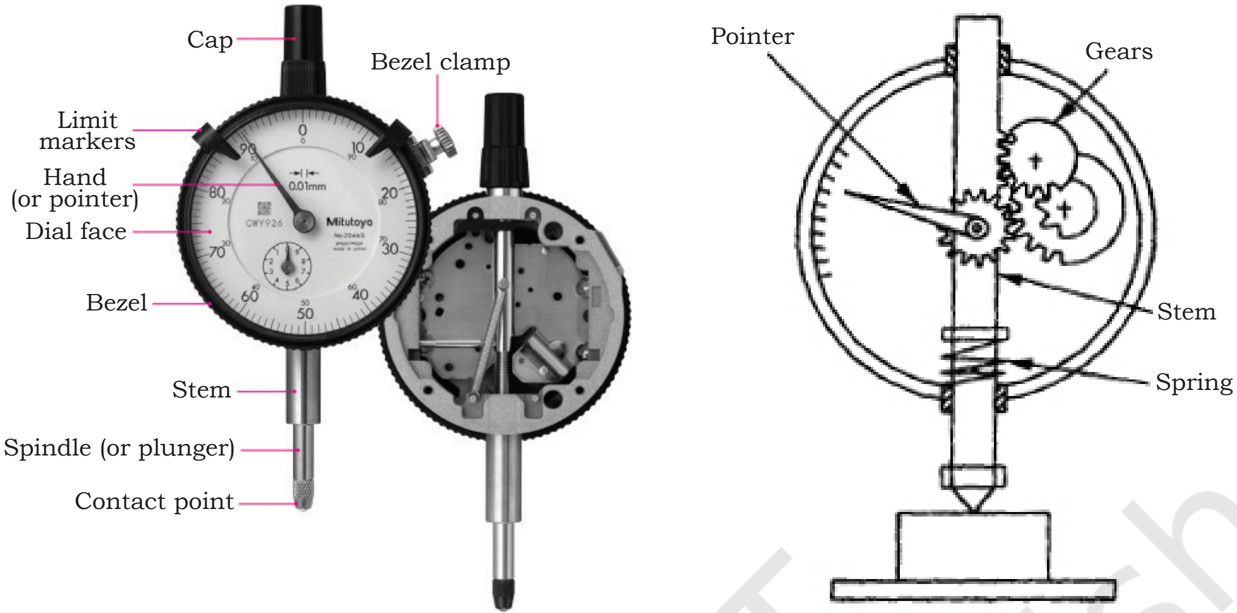
C. Answer the following questions

1. Explain the importance of angular measurement and measuring instruments.
2. What is the difference between a protractor and blade protractor?
3. Explain the procedure for using a bevel gauge.
4. How do we determine the least count of universal bevel protractor?

NOTES

SESSION 3: DIAL INDICATOR OR GAUGE AND OTHER GAUGES

A dial gauge (Fig. 4.17) is like a fine watch. It consists of a graduated dial, pointer, plunger and a clamp. It measures the displacement of its plunger on a circular dial by means of a rotating pointer. It is a measuring device that measures the accuracies in alignment and



Parts of dial gauge

Mechanism of dial gauge

Fig. 4.17: Dial gauge

eccentricity of the parts or components. Dial indicators are also great for checking crankshaft runout, crank end play, shaft thrust, gear backlash, flywheel face runout, flywheel housing concentricity, valve seat concentricity or piston deck clearance.

It works on the rack and pinion principle. The stem or plunger has rack teeth. A set of gears engage with the rack. The pointer is connected to a small pinion. This small pinion is independently hinged, i.e., it is not connected to the stem. The vertical movement of the stem is transmitted to the pointer through a set of gears. A spring gives a constant downward pressure to the stem.

Thus, any movement of the plunger causes a corresponding movement of the main pointer on a graduated dial. In addition to the main pointer the dial gauge has a secondary scale and a small pointer for indicating the number of revolutions made by the main pointer. Zero setting of the main pointer of the dial gauge can be done by rotating the dial face until '0' line coincides with the pointer. For use, a dial gauge is attached to the magnetic mounting stand (Fig.4.18) and the base of the stand is held on a flat surface.

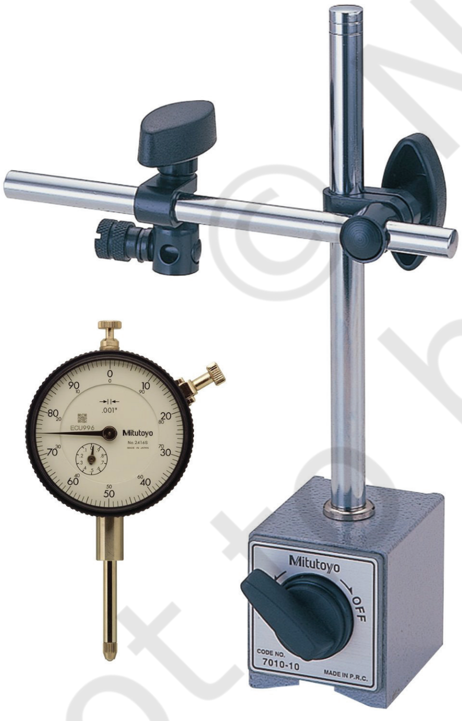


Fig. 4.18: Dial gauge mounting stand

The contact point of the stem is brought in contact with the part to be inspected. The part is rotated or translated and deviations in readings are observed on the dial face with the movement of pointer.

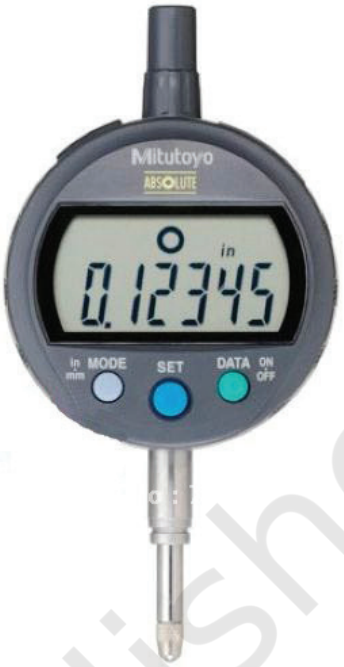


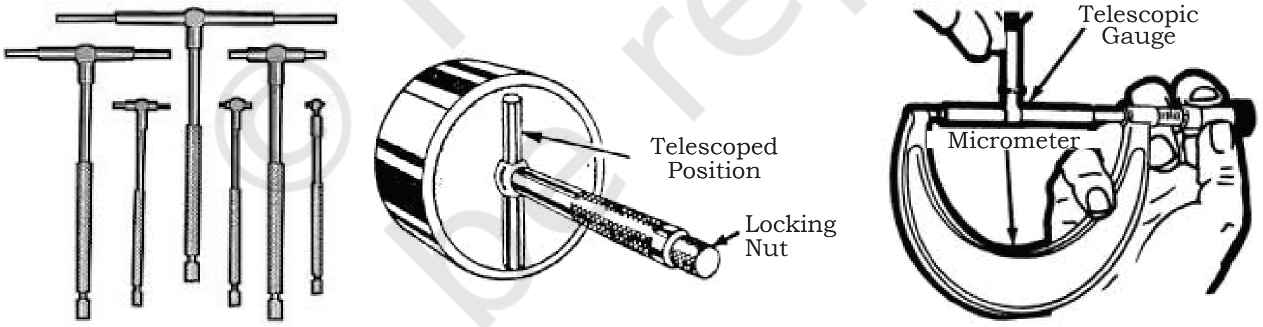
Fig. 4.19: Digital dial gauge

Digital Dial Indicator or Gauge

Its use is similar to a dial indicator or gauge and it uses an inductive measuring system and has LCD display. It has on/off function, zero setting at any position, hold function and plus-minus preset function. It is also used in conjunction with a magnetic base stand. The reading is displayed on the dial (Fig.4.19).

Telescopic Gauge

A telescopic gauge is a measuring tool with spring-loaded plungers used together with a micrometer to measure the inside of holes or bores. Telescopic are used to measure a bore's size, by transferring the internal dimension to a remote measuring tool. It is equivalent to inside calipers and the user gets the correct feel of repeatable results. Telescopic gauge is also used to find out the internal diameter of pipe, cylinder bore and slots. A telescoping gauge can be positioned inside holes or openings and then extended to touch the walls. They are made as insets to measure from small to very large bores (Fig.4.20).



Telescopic gauges

Using telescopic gauge

Measuring telescopic gauge with micrometer

Fig. 4. 20: Telescopic gauge and applications

Measuring diameter of bore with telescopic gauge

- Select appropriate size of telescopic gauge according to the bore.
- Press the plungers in the barrel and lock the ratchet.

- Place the gauge in a cylinder bore to check internal diameter.
- Turn the ratchet, the spring loaded plungers will come out and touch the side of the bore and exert equal pressure on both side of the cylinder wall. However, ensure that the gauge is held with the telescoping end at right angles to the axis of the hole to measure the true, maximum diameter.
- Rock the gauge back and forth to be sure it is square in the bore and the gauge parallel to the ground.
- Lock the telescopic gauge, plunger remains open and occupies the internal diameter.
- Slowly remove the telescopic gauge from the bore and measure across the two ends of the plungers with an outside micrometer.
- This gives main reading of cylinder bore.

Bore Gauge

A bore gauge measures a bore directly.

Dial bore gauge

It is a special tool, which is used to accurately measure the inside diameter of a hole, cylinder or pipe (Fig.4.21). It also detects ovality and tapers in bores. Dial bore gauges do the checking for taper or out-of-round conditions in a cylinder bore. Bore gauge measures the exact reading of a bore size. It consists of a shaft with a dial indicator at the top and a measuring sled at the base. The measuring sled consists of three guides and an actuating plunger. Dial bore gauges measure quick and accurate readings.

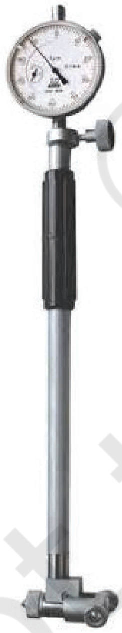


Fig. 4.21: Dial bore gauge

Measuring the bore size with Dial Bore Gauge

1. Zero the dial bore gauge against a calibrated ring of the same relative size as the bore.
2. Insert the head of the gauge into the bore following the tool's operating instructions. Rock the tool back and forth gently in the bore once the gauge is inserted and standing upright.
3. Watch the readout on the dial face as you rock the gauge back and forth. Record the value of the largest deviation away from '0' on the dial face.

Record the deviation as a positive number if it falls to the right of "0" and a negative number if it falls to the left of "0".

4. Look at the reading. This is the lowest reading, which is taken when the gauge is square on the bore, and the indicator needle reverses its direction. It can be either more or less than the zero mark, and will indicate an oversized or undersized bore.
5. Add or subtract the value of the largest deviation from the calibrated value of the bore gauge. If the gauge was zeroed at 100 mm, and the largest deviation a 0.5 mm to the right of the '0' on the dial face, then the final measurement of the bore is 100.5 mm. Alternatively, if the largest deviation was 0.5 mm to the left of the '0' on the dial face of a gauge calibrated to 100 mm, then the final measurement of the bore is 99.5 mm. Fig.4.22 and 4.23 shows a dial bore gauge.

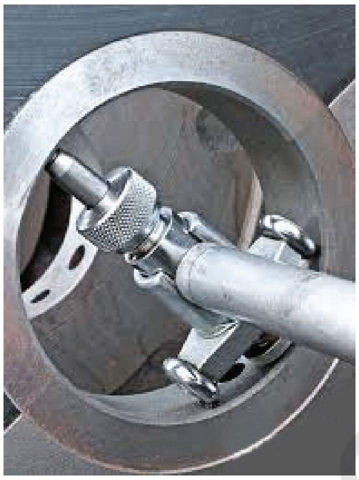


Fig. 4.22: Using bore gauge showing measuring sled

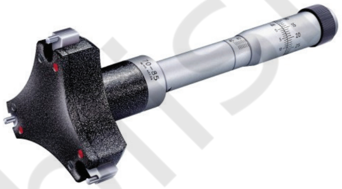


Fig. 4.23: Micrometer bore gauge

Precautions

Clean the hole to be measured and ensure that it is free of oil, grease or particles before introducing a precision measuring tool into the hole.

Never force precision measuring tools. Permanent and expensive damage may result and the tool will likely be ruined. Avoid shocks to the tool, such as dropping it or hitting it.

Screw Pitch Gauges

These devices are used to check the pitch of the thread immediately. It is necessary that everyday tool should be used to pick out a desired screw. The number of flat blades with different pitches is pivoted in a holder. The pitch value is marked on each blade. To know the pitch of any thread (nut, bolt, etc.), by visual inspection, the leaf is selected and placed on the profile of the thread. If the profile of screw pitch gauge leaf matches with the profile of the thread being inspected, the value of pitch is read from the leaf. If the profile does not match, another leaf is selected and the process repeated till the profiles match. It must be ensured that during matching, air or

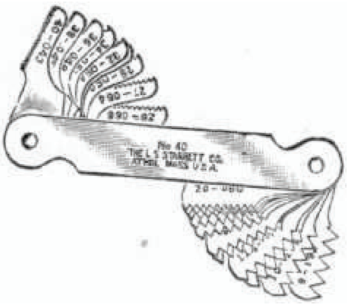


Fig. 4.24: Screw pitch gauge

light should not pass through the profiles. The screw pitch gauge is shown in Fig.4.24.

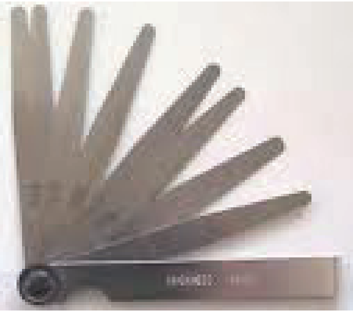


Fig. 4.25: Feeler gauge

Feeler Gauges

These gauges are used for checking the clearance between mating surfaces. They are mainly used in adjusting the valve clearance and setting of spark plug gaps in automobiles. They are made from 0.03 to 1.0mm thick of 100mm long leaves. The blades are pivoted in a holder. The value of thickness of the leaf is marked or engraved on it. To know or adjust the clearance or gap, the leaf of the feeler gauge is selected and inserted in the gap. The leaf should not be loose or inserted with force. The leaf should go in the gap with slight drag or resistance. The value of the clearance or gap is read from the leaf of feeler gauge (Fig.4.25).

Practical Exercise

1. Various types of gauges are used for checking components of automobile. Make a list of these gauges.

S.No.	Name of gauge

2. Draw and show the working principle of dial gauge and label the parts.

Check Your Progress

A. Fill in the blanks

1. Dial gauge is used as a measuring device to measure the accuracies in ___________, ___________ of the parts or components.

2. Dial gauge works on the ____________ and ____________ principle.
3. A telescoping gauge is a measuring tool with spring-loaded ____________ used together with a ____________.
4. A vernier bore gauge measures a ____________ directly.
5. A dial bore gauge is a special tool, which is used to accurately measure the inside _______ of a hole, cylinder or pipe and detect ________ and tapers in bores.
6. Screw pitch gauges are used to check the ________ of the thread immediately.
7. Feeler gauges are used for checking the clearance between _________ surfaces.

B. Multiple choice questions

1. Which of these is not a part of dial indicator?
   (a) graduated dial
   (b) pointer
   (c) plunger
   (d) lamp
2. A dial indicator or gauge works on which principle?
   (a) Rack and pinion
   (b) Torque
   (c) Moving
   (d) Helix
3. Which device is used to measure a bore's size?
   (a) Telescope Gauge
   (b) Bore Gauge
   (c) Comparator
   (d) Micrometer

C. Answer the following questions

1. What is the importance of a dial indicator or gauge?
2. Explain the working principle of a dial gauge.
3. What is a feeler gauge?
4. List the steps required to measure the bore of an object with the help of a dial bore gauge.
5. What is a screw pitch gauge? Give its application.

Session 4: Instruments on the Dashboard of a Vehicle

A dashboard is like a control panel placed in front of the driver. The dashboard has a cluster of instruments and

Notes

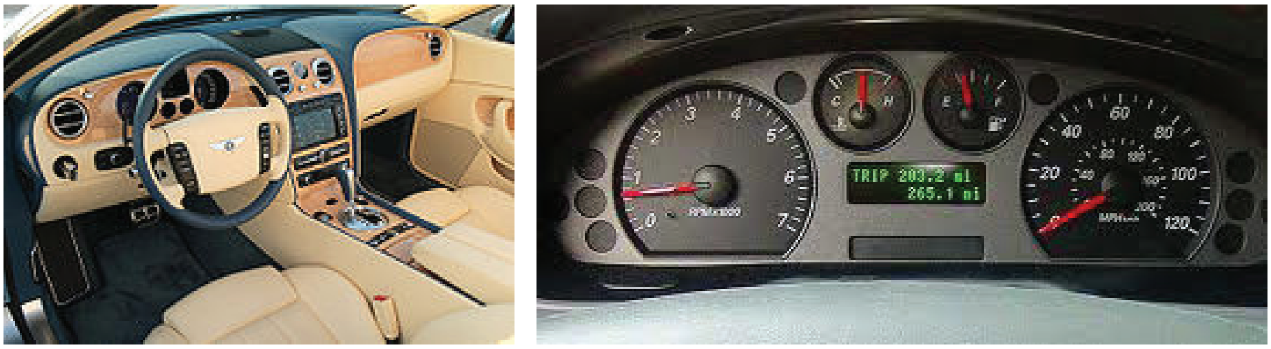


Fig. 4.26: Dash board and instrument panel of a vehicle

gauges, such as speedometer, tachometer, odometer and fuel gauge, and indicators, such as gearshift position, seat belt warning light, parking-brake-engagement warning light and an engine-malfunction light, which convey the health of vehicle to the driver. It also has indicators for low fuel, low tyre pressure, low oil pressure, and faults in the airbag (SRS) system, ventilation controls, lighting controls, audio equipment and automotive navigation systems, mounted on the dashboard. The top of a dashboard generally contains vents for an air conditioning and heating system and speakers for an audio system, a compartment is commonly located on the passenger's side for keeping gloves, etc. An ashtray, a power outlet for low-voltage appliances is also fitted.

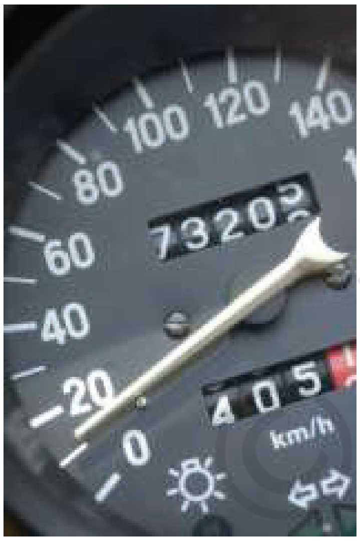


Fig. 4.27: Speedometer

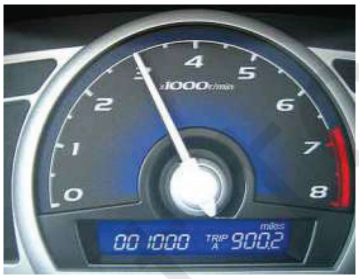


Fig. 4.28: Tachometer

Important Components of Dashboard

Every component fitted in dashboard indicates working of particular section. The important components of a dashboard are as follows:

Speedometer

The speedometer indicates the speed of a vehicle. Speed is measured in kilometers per hour. The control of vehicle rests with the driver, therefore, the speedometer helps the driver to keep the speed in safe limit. Fig.4.27 shows speedometer.

Tachometer

Tachometer (Fig.4.28) indicates how fast the engine is turning in revolutions per minute (rpm).

A driver should avoid running the engine in 'danger zone'. If the driver notices that the tachometer is reading abnormally high on accelerating, it indicates problems and the need to get the vehicle checked at service station.

Odometer

An odometer (Fig.4.29) is a tool that shows the distance travelled by a vehicle. The device may be electronic, mechanical, or a combination of both.

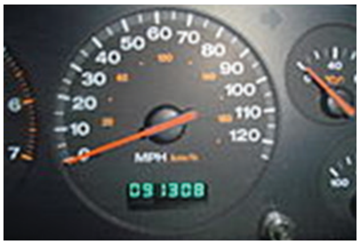


Fig. 4.29: Odometer

Fuel gauge

The fuel gauge (Fig.4.30) informs about the status and amount of fuel in the tank of vehicle. It should be regularly checked to avoid being stranded on road.

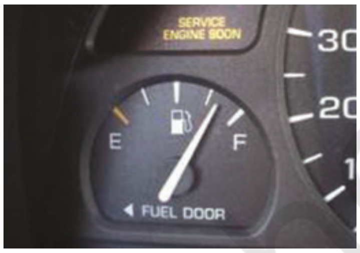


Fig. 4.30: Fuel gauge

Temperature gauge

The temperature gauge of a vehicle (Fig.4.31) measures the temperature of the engine's coolant. Most gauges measure temperature ranges. If a vehicle's temperature gauge is in the hot range, it needs to be moved to a safe place and stopped immediately.

When temperatures are consistently above the vehicle's normal range, it could indicate trouble with the cooling system.

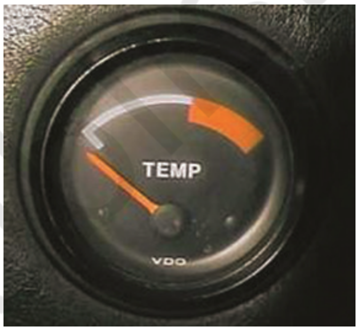


Fig. 4.31: Temperature gauge

Malfunction indicator lamp

It is also known as a check engine light, which indicates malfunction of a computerised engine management system. It can be seen on the instrument panel of most automobiles. When the MIL is on, the engine control unit stores a fault code related to the malfunction, which is checked with a scan tool and it is used for further diagnosis. The malfunction indicator lamp informs a driver through signal, such as check engine, service engine soon, or a pictogram of an engine (Figs.4.32 and 4.33).

In most cases, the light is not a sign of anything serious, due to which a lot of people ignore it. This may leads to problems in a vehicle and cause further damage.

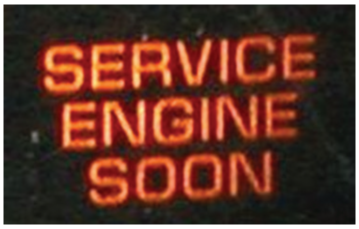


Fig. 4.32: MIL-Service Engine Soon

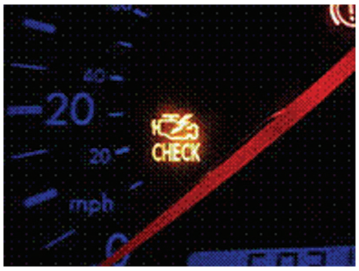


Fig. 4.33: MIL-Check Engine

Fig. 4.34: Navigator

Automotive navigation system

It is a satellite navigation system developed for use in automobiles. This system uses a GPS navigation device (Fig.4.34) to collect position data to locate the user on a road in the unit's map database. With the help of road database, the unit can inform about directions to other locations along roads, also present in its database. This unit can be fitted in dashboard of vehicle.

Driver information system (DIS):

Nowadays, most of the vehicles are fitted with DIS System. This system informs the driver about spontaneous fuel consumption, range of travel, available quantity of fuel in terms of kilometer, digital watch with atmospheric temperature.

Practical Exercise

1. List the important instruments which are fitted on the dashboard of a vehicle.

S.No.	Name of instrument

2. Draw the diagram of a dashboard with different instruments and components fitted on it and also label them.

Check Your Progress

NOTES

A. Fill in the blanks

1. The speedometer tells the driver about the ____________ of a vehicle.
2. Tachometer tells how fast engine is turning in ______ ________.
3. An odometer is an instrument that informs about the ___________ travelled by a vehicle.
4. The fuel gauge informs about the status of the ___________ of fuel in the vehicle tank.
5. The temperature gauge measures the temperature of an engine's ___________.
6. An automotive navigation system is a ___________ system suitable for use in automobiles.

B. Multiple choice questions

1. Which of these is not a component of the dashboard?
   (a) Speedometer
   (b) Tachometer
   (c) Odometer
   (d) Chassis
2. Speedometer measures the speed in ____________.
   (a) kilometres per hour
   (b) centimetres per hour
   (c) meters per hour
   (d) None of the above
3. Which of these devices are used to show the distance travelled by a vehicle?
   (a) Tachometer
   (b) Odometer
   (c) Speedometer
   (d) All of the above

C. Answer the following questions

1. What information is given by the speedometer?
2. What information is given by the odometer?
3. What is the use of a navigation system in vehicles?